



By email: advmn@trai.gov.in

June 1, 2023

Mr. Shri Akhilesh Kumar Trivedi
Advisor, Networks, Spectrum and Licensing
Telecom Regulatory Authority of India (TRAI)

RE: Comments on the Consultation Paper on Assignment of Spectrum for Space-based Communication Services

Kuiper Systems LLC (**Kuiper**), a wholly owned subsidiary of Amazon.com Services LLC (together, **Amazon**), welcomes the opportunity to submit these comments on the Consultation Paper on Assignment of Spectrum for Space-based Communication Services (**Consultation Paper**). As Amazon explains herein, the TRAI should recommend assigning spectrum for use by satellite communications providers via administrative assignment, rather than auction.

Background

Amazon plans to launch and operate Project Kuiper, a non-geostationary satellite orbit (**NGSO**) constellation consisting of over 3,000 satellites in low Earth orbit (**LEO**) that will provide ubiquitous, high-capacity, high-speed, low latency broadband services to residential customers, schools, and businesses, including those in remote communities in India, as well as telecommunications operators, global enterprises, and government users. Through Project Kuiper, Amazon will enable connectivity where it is lacking, thereby helping to close the Digital Divide and ensuring reliable access to communications.

Summary of Amazon's Submission

In its submission, Amazon first explains why administrative assignment of spectrum for use by satellite communications services is preferable to assignment via auction. Second, Amazon discusses why a Supreme Court case cited by the TRAI as requiring an auction for assignment of spectrum for use by satellite communications providers is, in fact, inapplicable and why the Government must consider different allocation methods. Amazon further explains why the proposal to impose spectrum sharing obligations after auctions would create inefficiencies and reduce the reliable and affordable connectivity options for customers. Finally, Amazon responds to questions specifically proposed by the TRAI that it does not address elsewhere in its comments.

A. General comments

a. Access to spectrum for satellite-based communications is essential for narrowing the “Digital Divide” and ensuring connectivity during natural disasters or other emergencies

In today's digital age, connectivity is increasingly important for accessing information, services, and opportunities, as well as enabling socio-economic growth. In contrast, limited access to connectivity leads to fewer economic opportunities and reduced access to education and healthcare, and hinders overall social and economic development. It can also widen the “Digital Divide” between those who have access to reliable and affordable internet connectivity, and those who do not. Indeed, satellite communications providers play a critical role in providing connectivity to customers, particularly in remote and underserved areas. Additionally, unlike terrestrial networks, satellite-based communications are less susceptible to disruption based on natural disasters or other emergencies. Satellite-based communications play a vital role in ensuring reliable connectivity no matter the events “on the ground.”¹

Customers rely on satellite communications services for internet connectivity (including for tele-health and educational uses), television programming, emergency communications, and other offerings. Satellite networks are often able to serve areas where it does not make economic sense to serve with terrestrial alternatives. If satellite operators are not able to access all the spectrum they require for their operations, their ability to offer these services would be negatively impacted and customers could see their costs increase, and could even lose access to life-saving information in the event of a natural disaster or other emergency that disrupts terrestrial networks.

Customers are not alone in benefiting from satellite-based services. Industry and government also benefit. For example:

- Start-ups (such as those that provide satellite-based IoT services) rely on satellite communications services to develop and bring new products and services to the country.
- Manufacturing industries rely on satellite communication services for their supply chain management, logistics, and other operations.
- Terrestrial mobile operators providing coverage in remote areas rely on satellite communications services for backhaul.
- Transportation, energy, and defence rely on satellite communications services for real-time tracking and monitoring.

¹ Indeed, and as is evident from the Government’s National Telecom Policy 2012, the Digital India Mission, and the NDCP 2018, the Government affords a special status to satellite communications based on its potential to provide connectivity during emergencies, in the face of climate change, and to counter threats to national security. See <https://dot.gov.in/sites/default/files/NTP-06.06.2012-final.pdf> and <https://digitalindia.gov.in/vision-vision-areas/>. The Government also notes that satellite communications technology can complement traditional terrestrial wireless telecommunications services in expanding the reach of 4G/5G networks to rural and inaccessible areas. See Response to Question 8, DoT’s Satellite Communication Reforms 2022, at <https://dot.gov.in/sites/default/files/Satellite%20Reforms%202022.pdf?download=1>. To achieve these socio-economic benefits and objectives, there is a need for efficient utilization and cost friendly availability of spectrum for all satellite communications.

Spectrum is also important to satellite communications providers themselves, not only because it allows them to provide the services they currently offer, but because spectrum unavailability reduces the incentive to invest in new technologies and, consequently, limits innovation.

b. The Inappropriateness of spectrum auctions for satellite-based communications

Auctions are typically used to assign exclusive rights of access to spectrum and to ensure that the winning bidder pays a premium to acquire that access. Here, however, the exclusive assignment of spectrum for use by satellite communications providers to a single entity would have multiple and specific negative impacts that should —and can— be avoided altogether.

Auctioning spectrum for satellite services would impose an artificial restriction on the effective sharing mechanism that is the norm in the satellite industry. Satellite technology allows multiple satellite operators to share the same spectrum in the micro/millimetre wave bands, and interference among different networks can be resolved effectively through well-tested frequency coordination mechanisms. Non-exclusive use of spectrum by satellite communications providers promotes spectral efficiency and the availability of satellite communications for the benefit of users throughout the coverage area. Conversely, an auction would unequivocally result in a fragmentation of available spectrum and limit the number of operators that could potentially access the same spectrum and offer much needed connectivity.

In addition, auctioning spectrum used for satellite services in the higher frequency bands would grant those entities capable of submitting the highest bid exclusivity over that spectrum, thereby blocking other potential users and artificially limiting competition to only a few players. Auctions can also result in higher prices for customers, as winning bidders pass through their spectrum acquisition costs. Small and medium-sized operators may lack the resources to participate in the auction altogether. Further, auctioning spectrum can result in inefficient uses of spectrum, as the winning bidders may not be the most efficient users of the spectrum in a particular frequency band. In addition, because satellite networks cover more than the territory of India, a spectrum assignment mechanism that artificially restricts sharing impacts operators' ability to serve multiple countries in the same region, where different assignment mechanisms would lead to inconsistent access. Thus, while auctions may be an appropriate method for assigning spectrum for terrestrial wireless networks, they are inappropriate for assigning spectrum for satellite networks.

c. Mandating spectrum sharing after assigning exclusive rights to such spectrum is inefficient

Although the TRAI already articulates many of the possible failure points to auctioning shared spectrum, we would like to emphasize a few points. Operators interested in providing satellite-based communications services will have a reduced interest in obtaining such spectrum through auction knowing this spectrum will later be shared, which will create an adverse impact on the dynamics of the auction and unpredictability in the price discovery mechanism. If sharing is introduced after an auction process, operators that do not win will have increased difficulty accessing spectrum, and the terms upon which winners may grant access are likely to be inconsistent and unpredictable. While limiting spectrum sharing to a few players might motivate bidders to bid higher, it will also significantly restrict competition and make the spectrum inaccessible to satellite start-up companies that are being encouraged by the Government to bring about disruption and self-reliance. The extra expenses built into bidding for spectrum will be passed along to end customers, which is not in the public interest. Further, operators' access to spectrum would be subject to auction cycles; this risks delaying the planning for and investments in deployment of satellite services.

Consequently, Amazon respectfully submits that an administrative assignment process, and not an auction, is the only way to ensure that the maximum public interest is met. An administrative assignment process would ensure that: (i) operators are able to efficiently deploy their networks and systems; (ii) customers, the satellite industry, and India's overall competitiveness and development benefit; (iii) operators are not artificially blocked from access to spectrum based on their ability to amass sufficient capital to submit winning bids; and (iv) operators are not subject to the procedures characteristic of an auction assignment process. Indeed, administrative assignment of spectrum for satellite services is the mechanism used by the majority of countries around the world.²

The potential risks stemming from the proposed auction of spectrum for the provision of satellite services will likely lead to a delay in the benefits that satellite-based communications services may guarantee in India, including to the development of an information society, the competitiveness of the country and, especially, the connectivity of the population.

d. The Indian legal framework regarding the assignment of spectrum

In the Consultation Paper, the TRAI notes that:

"[I]n another reference on 'frequency assignment for data communication services between aircraft and ground stations for services provided by organizations other than the Airport Authority of India' dated 12.04.2022, DoT has requested TRAI to provide recommendations on the following:

i. An appropriate mechanism to regulate the services provided by these organizations:

ii. The manner in which the frequency assignment should be made to these organizations, 'in light of the supreme Court judgment made in the 2G case in 2012 - to assign radio frequencies only through auction.'"

Indeed, the above seems to assume that spectrum for use by satellite communications services must be auctioned. As is explained more fully below, Amazon respectfully disagrees with this assumption and submits that the 2G Judgment, when viewed in the broader context of a subsequent 2012 five-judge Presidential Reference ruling³ and several other Supreme Court judgments,⁴ does not bind the Indian Government to assign spectrum only through auctions. In fact, a holistic reading of existing law and precedent indicates that spectrum for satellite communications should be assigned administratively.

e. The Supreme Court's 2G Judgment does not apply to the assignment of spectrum for satellite communications

² The TRAI itself acknowledges that around the world there is no precedent of auctioning spectrum in the higher frequency bands for satellite communications services. In the year 2000, the United States legally prohibited satellite spectrum from being auctioned by enacting the Orbit Act. Brazil, Mexico and other administrations have abandoned auction processes. In Thailand, the National Broadcasting and Telecommunications Commission recently conducted an auction for orbital slots and associated spectrum, and only saw two bidders, one of which was a government-owned company. Of the five orbital slots and associated spectrum that were put to auction, only three slots were sold. Even in India, it may be argued that auctions have not necessarily promoted competition in the telecommunications sector.

³ Judgment dated 27 September 2012 in Re: Special Reference 1 of 2012 ("Presidential Reference").

⁴ Kasturi Lai Lakshmi Reddy v. State of Jammu and Kashmir, AIR 1980 SC 1992; Tinsukhia Electric Supply Co. Ltd v. State Of Assam, AIR 1990 SC 123; Reliance Natural Resources Ltd. v. Reliance Industries Ltd. etc., (2010) 7 SCC 1.

In the 2G Judgment, the Supreme Court was asked to consider if specific assignments of spectrum for 2G should have been conducted on a first-come-first-served basis.⁵ The Supreme Court determined that the spectrum should have been auctioned. To avoid any confusion, especially on the issue of distribution methods of these types of resources, the then President of India sought clarity from the Supreme Court on the scope and applicability of the 2G Judgment.⁶ In paragraph 78 of the Presidential Reference judgment, the Supreme Court clarified that “[o]ur reading of these paragraphs suggests that the Court was not considering the case of auction in general, but specifically evaluating the validity of those methods adopted in the distribution of spectrum from September 2007 to March 2008.”⁷ The decision in the Presidential Reference confirms that the findings of the 2G Judgment are limited to the specific use case of distribution of spectrum from September 2007 to March 2008, and that the 2G Judgment does not lay down a general principle relating to auction.

The factual context of the 2G Judgment must also be considered. When deciding whether a first-come-first-served process was appropriate for the assignment of 2G spectrum, the Supreme Court assumed that terrestrial telecommunications providers would have exclusive rights to use a particular frequency band.⁸ Thus, the Supreme Court found that the first-come-first-served policy unfairly excluded other players from accessing spectrum.⁹ The Supreme Court also considered whether auctions would help meet the government’s objective of revenue maximization.¹⁰

These considerations are inapplicable to the question of how to assign spectrum for satellite communications services, including for the following reasons:

- First, unlike spectrum for terrestrial services, spectrum in the micro/millimeter wave bands used for satellite communications can be shared amongst multiple operators, subject to certain conditions.¹¹ There are no exclusive rights to use the spectrum or resultant exclusion of other operators. Satellite systems operate in frequency bands allocated internationally by the ITU and then reflected in domestic Tables of Frequency Allocations. In Article 9 of the Radio Regulations, the ITU lays out conditions for the sharing of satellite spectrum, which are aimed at managing potentially overlapping uses to avoid harmful interference among systems.¹² As the TRAI notes, spectrum in C-band, Ku-band, and Ka-band can be assigned to, and be shared among, different satellite communications service providers in the same geographical area.¹³ However, unlike satellite communications, terrestrial telecommunications providers require exclusive access to spectrum bands to be able to roll-out their services effectively and recoup their investment.¹⁴

⁵ Paragraph 1, Issues (iii) and (iv) framed by the Supreme Court, 2G Judgment.

⁶ Text of the President’s Reference to the Supreme Court, as contained in the Presidential Reference judgment.

⁷ In Paragraph 78 of the Presidential Reference judgment, the Supreme Court further noted that “*the recommendation of auction for alienation of natural resources was never intended to be taken as an absolute or blanket statement applicable across all natural resources, but simply a conclusion made at first blush over the attractiveness of a method like auction in disposal of natural resources. The choice of the word ‘perhaps’ suggests that the learned Judges considered situations requiring a method other than auction as conceivable and desirable.*”

⁸ Paragraph 75, 2G Judgment.

⁹ Paragraph 76, 2G Judgment.

¹⁰ Arguments of the Petitioner in the 2G Judgment, as reiterated in the Presidential Reference judgment, captured in Paragraph 116, Presidential Reference judgment.

¹¹ Paragraph 3.28, TRAI Consultation Paper on Assignment of Spectrum for Space-based Communication Services.

¹² See, <https://www.itu.int/hub/2021/11/managing-radio-frequency-spectrum-amid-a-new-space-race/>.

¹³ Paragraph 3.28, TRAI Consultation Paper on Assignment of Spectrum for Space-based Communication Services.

¹⁴ See, <https://www.gsma.com/spectrum/wp-content/uploads/2022/06/5G-Spectrum-Positions.pdf>.

- Second, the policy objective for the assignment of spectrum for use by satellite communications providers is also different, focusing on connecting underserved areas of the country as opposed to revenue maximization.¹⁵ The business model of satellite communications providers is distinct from that of terrestrial wireless telecommunications companies, including in terms of infrastructure costs and coverage areas. Thus, while satellite communications providers can serve remote and underserved areas without additional outlays of capital that would not be supported by subscription fees or other such revenue, terrestrial wireless operators focus instead on densely populated areas with larger customer bases, lower infrastructure costs per user and, generally, higher ARPUs.¹⁶

These factual differences are critical, and further support Amazon's contention that the preference for auctions established in the 2G Judgment should not apply to the assignment of spectrum for satellite services. In its reference dated 13 September 2021, there is an equivalence assumed between the usage of spectrum for satellite communications services to that of terrestrial wireless telecommunications services. However, as discussed herein, satellite spectrum is intrinsically different than terrestrial wireless spectrum. Treating them both the same by applying the same assignment methodology would be inequitable, akin to treating unequals equally.¹⁷

Finally, additional precedent confirms that the Government can consider various methods of the assignment of spectrum, including administrative assignments, and is not limited by the findings in the 2G Judgment.¹⁸ Several Supreme Court judgments direct the Government to conduct periodic evaluations of existing distribution modes so that natural resources are allocated for optimum utilization.¹⁹ At the same time, the Supreme Court has held that the Government cannot make long-lasting rules on resource allocations that restrict utilization to address only current needs.²⁰ To the extent that the Supreme Court of India has considered spectrum akin to a natural resource,²¹ Amazon submits that this precedent confirms that the Government, having the necessary technical competence, is empowered and mandated to revisit its existing spectrum distribution mechanisms so that maximum utility can be derived from

¹⁵ Paragraph 1, Mission, National Telecom Policy 2012, <https://dot.gov.in/sites/default/files/NTP-06.06.2012-final.pdf>; Paragraph 1.3, Mission, National Digital Communications Policy 2018, <https://dot.gov.in/sites/default/files/EnglishPolicy-NDCP.pdf>; Introduction, Explanatory Note to the draft Indian Telecommunication Bill 2022, <https://dot.gov.in/sites/default/files/Explanatory%20Note%20to%20the%20draft%20Indian%20Telecommunication%20Bill%2C%202022.pdf>.

¹⁶ See, https://www.itu.int/en/itu/news/Documents/2019/2019-04/2019_ITUNews04-en.pdf.

¹⁷ See Indian Constitution, Article 14 (mandating equality amongst equals).

¹⁸ Indeed, there are existing alternatives to auctions under Indian law. For example, the Mines and Minerals (Regulation and Development) Act, 1957, prescribes other, non-auction methods for the dispensation of natural resources. Additionally, the Biological Diversity Act 2002 mandates the National Biodiversity Authority (NBA) regulate and grant access rights to biological resources as it deems fit in the best interest of the biological resources. Prior approval of the NBA is necessary for accessing biological resources, and the NBA can impose benefit-sharing conditions upon applicants. This suggests that executive bodies have authority under existing Indian laws to distribute resources using methods other than auctions.

¹⁹ Paragraph 250 (3) and (4), *Reliance Natural Resources Ltd. v. Reliance Industries Ltd. etc.*, (2010) 7 SCC 1.

²⁰ Paragraph 3, *Monnet Ispat and Energy Ltd. v. Union of India*, JT 2012 (7) SC 50; MANU/SC/0601. The Supreme Court held that "*Management of minerals should be in a way that helps in country's economic development and which also leaves for future generations to conserve and develop the natural resources of the nation in the best possible way*".

²¹ The constitutional principles referenced when determining the appropriate mechanism for distribution of natural resources are "maximum public interest," "common good," and "public trust." Administrative assignment is one mechanism that can be used to advance these principles.

satellite communications. To do that, it can consider different methods of assignment of spectrum, including administrative assignments.²²

B. Specific comments on the issues for consultation

Q1. For space-based communication services, what are the appropriate frequency bands for (a) gateway links and (b) user links, that should be considered under this consultation process for different types of licensed telecommunications and broadcasting services? Kindly justify your response with relevant details.

Q2. What quantum of spectrum for (a) gateway links and (b) user links in the appropriate frequency bands is required to meet the demand of space-based communication services? Information on present demand and likely demand after about five years may kindly be provided in two separate tables as per the proforma given below:

Space-based communications play a critical role in a variety of applications, including remote sensing, earth observation, weather forecasting, navigation, satellite television, broadband internet, and many others. In turn, different frequency bands and services have different characteristics that make them suitable for specific types of applications. For example, higher frequency bands, such as Ku-band, Ka-band and Q/V band frequencies, are ideal for broadband satellite communications because they offer high data rates, while lower frequency bands, such as L-band and S-band frequencies, are better suited for navigation and remote sensing applications because they penetrate through clouds and other objects. Therefore, it is important to have access to a diverse set of frequency bands and services that can support these applications.

Additionally, the demand for spectrum will only increase with the growing use of satellite-based services, so the availability of the maximum amount of spectrum possible can help meet this demand and ensure its efficient use while avoiding interference.

Q3. Whether there is any practical limit on the number of Non-Geo Stationary Orbit (NGSO) satellite systems in Low Earth Orbit (LEO) and Medium Earth Orbit (MEO), which can work in a coordinated manner on an equitable basis using the same frequency range? Kindly justify your response.

While there may be a theoretical limit on the number of NGSO FSS systems that can operate in a coordinated manner, such number is not static and would depend on various technical and regulatory factors, such as the frequency bands used, the satellite orbits, the power levels, the antenna beam widths, and the degree of frequency coordination among the various systems, among others. Amazon submits that such theoretical limitation is not a determinant for the assessment the TRAI conducts in its Consultation Paper, as frequency coordination among NGSO FSS systems is typically conducted to avoid interference and to ensure the efficient use of the same spectrum by multiple systems. Administrations continue to submit a significant number of NGSO filings to the ITU, confirming there is additional opportunity for more systems.

Q4. For space-based communication services, whether frequency spectrum in higher bands such as C band, Ku band and Ka band, should be assigned to licensees on an exclusive basis? Kindly justify your

²² See also Paragraph 130-131 of the Presidential Reference judgment.

response. Do you foresee any challenges due to exclusive assignment? If yes, in what manner can the challenges be overcome?

Kindly elaborate the challenges and the ways to overcome them.

Q5. In case it is decided to assign spectrum in higher frequency bands such as C band, Ku band and Ka band for space-based communication services to licensees on an exclusive basis,

(a) What should be the block size, minimum number of blocks for bidding and spectrum cap per bidder? Response may be provided separately for each spectrum band.

(b) Whether intra-band sharing of frequency spectrum with other satellite communication service providers holding spectrum upto the prescribed spectrum cap, needs to be mandated?

(c) Whether a framework for mandatory spectrum sharing needs to be prescribed? If yes, kindly suggest a broad framework and the elements to be included in the guidelines.

(d) Any other suggestions to ensure that the satellite communication ecosystem is not adversely impacted due to exclusive spectrum assignment, may kindly be made with detailed justification.

Kindly justify your response.

Q6. What provisions should be made applicable on any new entrant or any entity who could not acquire spectrum in the auction process/assignment cycle?

(a) Whether such entity should take part in the next auction/ assignment cycle after expiry of the validity period of the assigned spectrum? If yes, what should be the validity period of the auctioned/assigned spectrum?

(b) Whether spectrum acquired through auction be permitted to be shared with any entity which does not hold spectrum/ or has not been successful in auction in the said band? If yes, what measures should be taken to ensure rationale of spectrum auction and to avoid adverse impact on the dynamics of the spectrum auction?

(c) In case an auction based on exclusive assignment is held in a spectrum band, whether the same spectrum may again be put to auction after certain number of years to any new entrant including the entities which could not acquire spectrum in the previous auction? If yes,

(i) After how many years the same spectrum band should be put to auction for the potential bidders?

(ii) What should be the validity of spectrum for the first conducted auction in a band? Whether the validity period for the subsequent auctions in that band should be co-terminus with the validity period of the first held auction?

Kindly justify your response.

Q7. Whether any entity which acquired the satellite spectrum through auction/assignment should be permitted to trade and/or lease their partial or entire satellite spectrum holding to other eligible service licensees, including the licensees which do not hold any spectrum in the concerned spectrum band? If yes, what measures should be taken to ensure rationale of spectrum auction and to avoid adverse impact on the dynamics of the spectrum auction? Kindly justify your response.

Q8. For the existing service licensees providing space-based communication services, whether there is a need to create enabling provisions for assignment of the currently held spectrum frequency range by them, such that if the service licensee is successful in acquiring required quantum of spectrum through auction/ assignment cycle in the relevant band, its services are not disrupted? If yes, what mechanism should be prescribed? Kindly justify your response.

As detailed in our general comments, the exclusive assignment of spectrum for the provision of satellite services to a single entity will have multiple and specific negative impacts that should - and can - be avoided altogether. The present set of questions assume that there is a need to artificially create scarcity and use auctions as a methodology, although it also recognizes the need to correct or subvert the main characteristics of such procedures. However, as thoroughly detailed in our general comments, the decision to auction spectrum for satellite-based communications is not mandated by court decisions or otherwise required under Indian law.

As such, Amazon respectfully submits that the methodology that should be used for spectrum assignments for satellite communications is the one that promotes the availability of spectrum to multiple entities. Such an approach fosters competition and leads to increased innovation, better quality of services, and more competitive prices. This will ultimately be the only method that benefits customers and promotes growth in India.

Q9. In case you are of the opinion that the frequency spectrum in higher frequency bands such as C band, Ku band and Ka band for space-based communication services should be assigned on shared (nonexclusive) basis, -

(a) Whether a broad framework for sharing of frequency spectrum among satellite communication service providers needs to be prescribed or it should be left to mutual coordination? In case you are of the opinion that broad framework should be prescribed, kindly suggest the framework and elements to be included in such a framework.

(b) Any other suggestions may kindly be made with detailed justification.

Kindly justify your response.

The sharing of spectrum among various satellite operators/service providers is governed by Article 9 of the ITU Radio Regulations (RR). The RR provide detailed guidelines on the sharing and coordination of spectrum. We submit that the terms for sharing spectrum among satellite communications providers should be left to frequency coordination, and parties engaged in the coordination should be required to notify the Indian Administration of how they intend to avoid interference before they can be licensed to operate in the country.

Q10. In the frequency range 27.5-28.5 GHz, whether the spectrum assignee should be permitted to utilize the frequency spectrum for IMT services as well as space-based communication services, in a flexible manner? Do you foresee any challenges arising out of such flexible use? If yes, in what manner can the challenges be overcome? Kindly elaborate the challenges and the ways to overcome them.

Q11. In case it is decided to permit flexible use in the frequency range of 27.5 - 28.5 GHz for space-based communication services and IMT services, what should be the associated terms and conditions including eligibility conditions for such assignment of spectrum? Kindly justify your response.

Q12. Whether there is a requirement for permitting flexible use between CNPN and space-based communication services in the frequency range 28.5-29.5 GHz? Kindly justify your response.

Q13. Do you foresee any challenges in case the spectrum assignee is permitted to utilize the frequency spectrum in the range 28.5-29.5 GHz for cellular based CNPN as well as space-based communication services, in a flexible manner? What could be the measures to mitigate such challenges? Suggestions may kindly be made with justification.

Amazon sees inevitable challenges in the allocation of frequency bands for multiple and technologically different services. While it may be possible to address some of these challenges (e.g., use of the 27.5-28.5 GHz band by both IMT and satellite gateway stations), such co-existence among services would inevitably deteriorate the quality of the services and put undue constraints on either or both services. It is worth pointing out that it would be impossible to coordinate IMT terrestrial deployments and satellite customer terminal deployments in the same frequency band. Thus, we submit that the actual need of these frequency bands for each service should be thoroughly assessed considering the current use and demand for spectrum already assigned (for example, in the case of IMT-based services and considering the result of the latest assignments).

As far as the flexible use of a frequency range for different services by the same operators, spectrum that is assigned either through auction or an administrative mechanism is assigned for a given service. Flexible use of spectrum by terrestrial and space-based systems would create an imbalance where spectrum assigned for IMT (allowing flexible use) could be used for both satellite gateway stations, Earth Stations in Motion (**ESIM**), and customer terminal operations, whereas spectrum assigned for satellite use would be permitted only for gateway stations and ESIM and not for customer terminal use. Amazon does not see a need for such flexible use, nor adequate technical solutions given the characteristics of each operation.

Additionally, we note that the rollout of terrestrial mobile wireless services in the millimetre wave bands to date have been less than initially envisioned:

- South Korea, which took the lead in allocating the 28 GHz band for IMT services, has publicly admitted that these spectrum assignments have failed.²³
- South Korean operator, SK Telecom, decided to cease using 28 GHz for 5G. The decision follows the footsteps of peer carriers KT and LG Uplus, leaving no carriers using 28 GHz for 5G in South Korea.²⁴
- In Japan, terrestrial mobile operators have not been able to use the 28 GHz band allocated for IMT services, and are far behind their rollout requirements.²⁵
- Thailand conducted studies on the co-existence of IMT and satellite deployments in the 28 GHz band, and decided to allocate the 28 GHz band only for satellite service use.²⁶
- In the USA, terrestrial mobile operators such as T-Mobile and Verizon have not been able to successfully use the 28 GHz band.

On the issue of the allocation of the 28.5-29.5 GHz band to CNPN services, it is often misunderstood that CNPN services are indoor usage services. On the contrary, the CNPN services are deployed by organizations for private networks that span across campuses, which may be adjacent to satellite deployments. It would be next to impossible to coordinate satellite user terminals with CNPN service use, and this could cause considerable deterioration of one or both of the services.

Thus, we urge the TRAI to rethink the allocation of the 28 GHz band to both IMT and CNPN, considering that terrestrial deployments in this band have not succeeded anywhere in the world. On the contrary, the

²³ See, <https://www.rcrwireless.com/20230103/5g/south-korea-officially-cancels-28-ghz-licenses-report>.

²⁴ See, <https://telecomtalk.info/sktelecom-stop-using-28ghz-band-for-5g/701822/>.

²⁵ See, https://www.soumu.go.jp/main_content/000860636.pdf.

²⁶ See, <https://dpolit.com/2023/01/08/thailand-secures-next-generation-inflight-connectivity-nbtc-allocates-the-full-28-ghz-spectrum-band-for-satellite-broadband/>.

satellite industry is using the 28 GHz band extensively, to provide broadband in unserved and underserved areas of the world for the benefit of customers who require these services.

Q14. Whether space-based communication services should be categorized into different classes of services requiring different treatment for spectrum assignment? If yes, what should be the classification of services and which type of services should fall under each class of service? Kindly justify your response. Please provide the following details:

a) Service provider-wise details regarding financial and market parameters such as total revenue, total subscriber base, total capital expenditure etc. for each type of service (as mentioned in the Table 1.3 of this consultation paper) for the financial year 2018-19, 2019-20, 2020-21, 2021-22, and 2022-23 in the format given below:

b) Projections on revenue, subscriber base and capital expenditure for each type of service (as mentioned in the Table 1.3 of this consultation paper) for the whole industry for the next five years starting from financial year 2023-24, in the format given below:

Q15. What should be the methodology for assignment of spectrum for user links for space-based communication services in L-band and S-band, such as-

(a) Auction-based (b) Administrative (c) Any other?

Please provide your response with detailed justification.

Q16. What should be the methodology for assignment of spectrum for user links for space-based communication services in higher spectrum bands like C-band, Ku-band and Ka-band, such as

(a) Auction-based (b) Administrative (c) Any other?

Please provide your response in respect of different types of services (as mentioned in Table 1.3 of this consultation paper). Please support your response with detailed justification.

Q17. Whether spectrum for user links should be assigned at the national level, or telecom circle/ metro-wise? Kindly justify your response.

Q18. In case it is decided to auction user link frequency spectrum for different types of services, should separate auctions be conducted for each type of services? Kindly justify your response with detailed methodology.

Q19. What should be the methodology for assignment of spectrum for gateway links for space-based communication services, such as

(a) Auction-based

(b) Administrative

(c) Any other?

Please provide your response in respect of different types of services. Please support your response with detailed justification.

Q20. In case it is decided to auction gateway link frequency spectrum for different types of services, should separate auctions be conducted for each type of services? Kindly justify your response with detailed methodology.

Q21. In case it is decided to assign frequency spectrum for space-based communication services through auction,

(a) What should be the validity period of the auctioned spectrum?

(b) What should be the periodicity of the auction for any unsold/ available spectrum?

(c) Whether some mechanism needs to be put in place to permit the service licensee to shift to another satellite system and to change the frequency spectrum within a frequency band (such as Ka-band, Ku-band, etc.) or across frequency bands for the remaining validity period of the spectrum held by it? If yes, what process should be adopted and whether some fee should be charged for this purpose? Kindly justify your response.

Q22. Considering that (a) space-based communication services require spectrum in both user link as well as gateway link, (b) use of frequency spectrum for different types of links may be different for different satellite systems, and (c) requirement of frequency spectrum may also vary depending on the services being envisaged to be provided, which of the following would be appropriate:

(i) to assign spectrum for gateway links and user links separately to give flexibility to the stakeholders? In case your response is in the affirmative, what mechanism should be adopted such that the successful bidder gets spectrum for user links as well as gateway links.

or

(ii) to assign spectrum for gateway links and user links in a bundled manner, such that the successful bidder gets spectrum for user link as well as gateway link? In case your response is in the affirmative, kindly suggest appropriate assignment methodology, including auction so that the successful bidder gets spectrum for user links as well as gateway links.

Space-based communication services should not be categorized into different classes of services that require different treatment for spectrum assignment and, as justified in our general comments, Amazon submits that the methodology for the assignment of spectrum for any space-based communication services should be administrative. The assignment of spectrum for space-based communications should be on a national level, and the licensee should be able to choose the specific frequency ranges that are intended to be used for the gateway station links and the customer terminal links.

Q23. Whether any protection distance would be required around the satellite earth station gateway to avoid interference from other satellite earth station gateways for GSO/ NGSO satellites using the same frequency band? If yes, what would be the protection distance (radius) for the protection zone for GSO/ NGSO satellites?

Modern NGSO FSS systems employ frequency sharing techniques that can avoid harmful interference to other systems, such as angular avoidance and satellite selection. It is possible to co-locate both gateway stations and user terminals with other GSO/NGSO systems, by employing appropriate frequency coordination and mitigation mechanisms. No protection distances are warranted, and operators/service providers can be licensed after ensuring that such inter-system frequency coordination has been duly notified and/or such protection mechanisms against harmful interference, as prescribed by Article 22 and Resolution 76, have a favourable finding by the ITU.

Q24. What should be the eligibility conditions for assignment of spectrum for each type of space-based communication service (as mentioned in the Table 1.3 of this Consultation Paper)? Among other things, please provide your inputs with respect to the following eligibility conditions:

(a) Minimum Net Worth

(b) Requirement of existing agreement with satellite operator(s)

(c) Requirement of holding license/ authorization under Unified License prior to taking part in the auction process.

Kindly justify your response

We refer to our general comments section, where we provide justification for the administrative assignment of spectrum for any space-based communication services. Further, the eligibility criteria for the various authorisations under the United License (UL) have already been prescribed, and the same can be applied for the administrative assignment of spectrum for space-based communications.

Q25. What should be the terms and conditions for assignment of frequency spectrum for both user links as well as gateway links for each type of space-based communication service? Among other things, please provide your detailed inputs with respect to roll-out obligations on space-based communication service providers. Kindly provide response for both scenarios viz. exclusive assignment and nonexclusive (shared) assignment with justification.

Q26. Whether the provisions contained in the Chapter-VII (Spectrum Allotment and Use) of Unified License relating to restriction on crossholding of equity should also be made applicable for satellite-based service licensees? If yes, whether these provisions should be made applicable for each type of service separately? Kindly justify your response.

We refer to our general comments section, where we provide justification for the administrative assignment of spectrum for any space-based communication services. Spectrum should be shared between all satellite operators seeking to access it. Thus, the restrictions on cross-holding of equity should not apply to an administrative assignment. Further to this point, the UL already contains the main set of obligations (including rollout obligations) inherent to the provision of the satellite-based communication services sought, within each service authorization.

Q27. Keeping in view the provisions of ITU's Radio Regulations on coexistence of terrestrial services and space-based communication services for sharing of same frequency range, do you foresee any challenges in ensuring interference-free operation of space-based communication network and terrestrial networks (i.e., microwave access (MWA) and microwave backbone (MWB) point to point links) using the same frequency range in the same geographical area? What could be the measures to mitigate such challenges? Suggestions may kindly be made with justification.

The co-existence of terrestrial and space-based communication services cannot be generalised. Frequency interference mitigation strategies have to be developed between concerned operators (both on the terrestrial wireless and space-based communications side), taking into account the frequency overlap, the various protection criteria already stipulated in the ITU RR, and by incorporating necessary protection distances, where required. The licensing conditions should stipulate a mutual frequency coordination requirement between the operators, with an oversight by DOT/WPC.

Q28. In what manner should the practice of assignment of a frequency range in two polarizations should be taken into account in the present exercise for assignment and valuation of spectrum? Kindly justify your response.

We refer to our general comments section where we provide justification for the administrative assignment of spectrum for any space-based communication services. Use of multiple polarizations is not only a capacity enhancing measure, but also a frequency interference mitigation technique. There should be no separate charges for the use of multiple polarisations.

Q29. What could be the likely issues, that may arise, if the following auction design models (described in para 3.127 to 3.139) are implemented for assignment of spectrum for user links in higher bands (such as C band, Ku band and Ka band)?

a. Model #1: Exclusive spectrum assignment

b. Model#2: Auction design model based on non-exclusive spectrum assignment to only a limited number of bidders

What changes should be made in the above models to mitigate any possible issues, including ways and means to ensure competitive bidding? Response on each model may kindly be made with justification.

Q30. In your opinion, which of the two models mentioned in Question 29 above, should be used? Kindly justify your response.

Q31. In case it is decided to assign spectrum for user links using model # 2 i.e., non-exclusive spectrum assignment to limited bidders ($n + \Delta$), then what should be

(a) the value of Δ , in case it is decided to conduct a combined auction for all services

(b) the values of Δ , in case it is decided to conduct separate auction for each type of service

Please provide detailed justification.

Q32. Kindly suggest any other auction design model(s) for user links including the terms and conditions? Kindly provide a detailed response with justification as to how it will satisfy the requirement of fair auction i.e., market discovery of price.

Q33. What could be the likely issues, that may arise, if Option # 1: (Area specific assignment of gateway spectrum on administrative basis) is implemented for assignment of spectrum for gateway links? What changes could be made in the proposed option to mitigate any possible issues?

Q34. What could be the likely issues, that may arise, if Option # 2: Assignment of gateway spectrum through auction for identified areas/ regions/ districts is implemented for assignment of spectrum for gateway links? What changes could be made in the proposed option to mitigate any possible issues? In what manner, areas/ regions/ districts should be identified?

Q35. In your view, which spectrum assignment option for gateway links should be implemented? Kindly justify your response.

Q36. Kindly suggest any other auction design model(s) for gateway links including the terms and conditions? Kindly provide a detailed response with justification as to how it will satisfy the requirement of fair auction i.e., market discovery of price?

Q37. Any other issues/suggestions relevant to the subject, may be submitted with proper explanation and justification.

We refer to our general comments section we provide justification for the administrative assignment of spectrum for any space-based communication services. Spectrum should be shared between all satellite operators seeking to access it. The assignment of spectrum should be at a national level, and should not be location-based for gateway stations. Since the 27.5-29.5 GHz band is allocated on a co-primary with Fixed Services (FS) stations (MWA/MWB), any location-based assignment for FSS stations will make frequency coordination very difficult, if not impossible.

In addition, for the smooth rollout of satellite services that can effectively address the connectivity needs of unserved and underserved areas in India, the TRAI should take into account the following issues:

1. The provision of internet services to customers in India can be effectively addressed by satellite services provided under the Internet Services Authorisation (or ISP License) of the UL. However, currently, there is no prescribed charging mechanism for spectrum for the provision of satellite services under the ISP License. We urge the TRAI to address this gap by recommending an administrative cost-based charging model for spectrum for providing satellite services under this authorization.
2. The UL allows the provision of satellite services under service authorisations with varied scope, such as GMPCS, VSAT CUG and ISP. In order to efficiently use spectrum, it should be feasible to deploy a single network that has access to spectrum and the service provided under different authorisations depending on the scope. In its recommendations on the use of VSAT for cellular backhaul connectivity, the TRAI recommended that the sharing of active and passive infrastructure owned by a licensee under any of the service authorisation be allowed.²⁷ However, the sharing of spectrum between service authorisations for the efficient use of spectrum was not addressed, and the same needs to be addressed.
3. WPC carries out frequency assignments through the issuance of Decision Letters. These letters assign frequencies on a carrier-by-carrier basis, which limits the operational flexibility of modern satellite systems that use dynamic frequency usage. There will be a significant administrative overhead resulting in delays of deployment of services if spectrum is to be assigned on a carrier-by-carrier basis. Instead, spectrum for satellite-based services should be assigned as a block, and the operator should have the flexibility to dynamically use the frequencies assigned across different customer terminals, gateway stations, and satellites serving India.

Q38. In case it is decided for assignment of spectrum on administrative basis, what should be the spectrum charging mechanism for assignment of spectrum for space-based communications services

- i. **For User Link**
- ii. **For Gateway Link**

Please support your answer with detailed justification.

We firstly urge the TRAI to recommend a charging mechanism for assignment of spectrum for space-based communications services aligned with an administrative cost-based charging model. Scarcity is sufficiently unlikely where satellite systems are efficiently accessing and using the same spectrum, and there is no need to account for potential opportunity costs that may otherwise justify an auction of the spectrum. Frequency coordination is also able to resolve conflicts between operators with regards to access to and use of the spectrum. Therefore, the overall level of fees for the spectrum used by satellite-based communications providers does not need to be any higher than necessary to cover the administrative assignment of the spectrum and the corresponding licensing costs.

An administrative cost-based charging model is the one that best ensures that the pricing structure for space-based communications is transparent and justifiable, as operators are charged based on the actual costs they impose on the regulatory authority, thus leading to a more equitable distribution of expenses and an incentive to use spectrum efficiently. In addition, an administrative cost-based charging model for spectrum pricing for satellite-based communications (i) facilitates investment and innovation by ensuring

²⁷ Clause 3.4 [Para 2.43] of Chapter 3 of the recommendations on “Provision of Cellular Backhaul Connectivity via satellite through VSAT under Commercial CUG Service authorization” dated 28th July 2020.

cost predictability; (ii) creates a level playing field that fosters competition in the provision of services; and, overall, (iii) supports the financial sustainability of spectrum management.

The current methodology of charging for spectrum varies across the different service authorizations under the UL: the charging mechanism for the CUG VSAT authorisation is defined as a percentage of AGR, while the charging mechanism for the GMPCS authorization is based on the quantity of spectrum and calculated using a formula that takes into account the spectrum used by each carrier in a network and rounding off to the nearest MHz.

Considering the scope of each service authorization varies, it is reasonable to assume that a satellite communications provider will seek multiple authorizations to address the different connectivity needs of its customers. As such, to efficiently utilize the assigned spectrum and provide services to various business segments, Amazon offers the following suggestions for consideration by the TRAI:

1. The charging mechanism needs to be unified across all service authorizations under the UL. This will allow for an efficient sharing of spectrum across the different service authorizations under the UL.
2. The charging mechanism should be uniformly applied for the gateway links and the user links. It is common practice for satellite operators/service providers to use spectrum for gateway stations and user terminals interchangeably.
3. In the case of the VSAT-CUG service authorization, in the past, the TRAI recommended a reduction of spectrum usage charges from 4% to 1%, with the rationale that 1% of AGR would adequately cover the administrative expenses incurred for managing the spectrum, thus emphasizing cost-recovery as a basis for charging for spectrum for satellite-based services.²⁸ The TRAI has reiterated the reduction of charges and the model on several occasions.²⁹
4. In the case of the GMPCS authorization, the TRAI recommended that the quantity-based charging mechanism should be converted to an AGR-based charging model, and the charges would need to be 1% of AGR.³⁰ This mechanism, when implemented, will create a uniform charging mechanism across the service authorizations.

In the event that the TRAI recommends a quantity of spectrum-based charging model, then the following issues need to be addressed:

1. Modern satellite networks re-use spectrum across different beams of the satellite, without impacting the sharing of the same set of frequencies with other satellites (both GSO and NGSO systems). In order to encourage such spectrum re-use, the charging mechanism should be designed to encourage re-use, which results in an efficient use of spectrum by all systems.
2. A similar approach needs to be followed for the use of multiple polarizations. Use of multiple polarizations enhances spectrum utilization, increasing its efficient use.
3. As stated in our response to Q37, above, the assignment and charging of spectrum should be as a block, as opposed to assigning and charging for spectrum on a carrier-by-carrier basis. This would give the satellite service provider flexibility to dynamically use the spectrum, and would simplify the calculation of the fees.

²⁸ See, https://www.trai.gov.in/sites/default/files/Recommendations_07032017.pdf.

²⁹ See, https://www.trai.gov.in/sites/default/files/Recommendations_26082021.pdf

³⁰ See, https://www.trai.gov.in/sites/default/files/Recommendations_26082021.pdf.

Q39. Should the auction determined prices of spectrum bands for IMT /5G services be used as a basis for valuation of space-based communication spectrum bands

- i. For user link**
- ii. For gateway link**

Please support your answer with detailed justification.

Reference to prices determined by auction of spectrum for IMT/5G services as a basis for the valuation of spectrum for space-based communications would not be appropriate for the following reasons:

1. IMT/5G deployments are envisaged only in a portion of the bands that are used for space-based communications (e.g., the 27.5-28.5 GHz band). Spectrum for space-based communications span across several frequency bands (e.g., L-, S-, C-, Ku-, Ka-, and Q/V bands). It would not be appropriate to apply an uniform valuation for spectrum across the bands listed above. The bands have different use cases, which have different revenue potential.
2. We emphasize that IMT/5G services requires an exclusive assignment of spectrum, whereas for space-based communications, a shared assignment of spectrum would be the most appropriate approach. Consequently, both of these cannot be equated in terms of charging of fees.

Q40. If response to the above question is yes, please specify the detailed methodology to be used in this regard?

Q41. Whether the value of space-based communication spectrum bands

- i. For user link**
- ii. For gateway link**

be derived by relating it to the value of other bands by using a spectral efficiency factor? If yes, with which spectrum bands should these bands be related to and what efficiency factor or formula should be used? Please support your response with detailed justification.

The value of frequency bands for space-based communications should not be derived by comparing the spectral efficiency in relation to other bands, as this would mean many other important factors would be left unconsidered. Factors such as propagation characteristics, atmospheric precipitation, and antenna characteristics can significantly alter spectral efficiency.

Q42. In case of an auction, should the current method of levying spectrum fees/charges for satellite spectrum bands on formula basis/ AGR basis as followed by DoT, serve as a basis for the purpose of valuation of satellite spectrum

- i. For user link**
- ii. For gateway link**

If yes, please specify in detail what methodology may be used in this regard.

Q43. Should revenue surplus model be used for the valuation of space-based spectrum bands

- i. For user link**
- ii. For gateway link**

Please support your answer with detailed justification.

Q44. Whether international benchmarking by comparing the auction determined prices of countries where auctions have been concluded for space-based communication services, if any, be used for arriving at the value of space-based communication spectrum bands:

- i. For user link**
- ii. For gateway link**

If yes, what methodology should be followed in this regard? Please give country-wise details of auctions including the spectrum band /quantity put to auction, quantity bid, reserve price, auction determined price etc. Please support your response with detailed justification.

Around the world, there are no examples of spectrum for satellite services in the microwave and millimetre wave bands being auctioned in order for satellite operators to access the necessary spectrum. There are instances in some countries of orbital slots and the corresponding spectrum being auctioned; however, satellite operators who operate satellites in orbital slots filed with the ITU by other Administrations (other than the local Administration) have not been subject to spectrum auctions to ensure access to the same spectrum.

Q45. Should the international administrative spectrum charges/fees serve as a basis/technique for the purpose of valuation in the case of satellite spectrum bands

i. For user link ii. For gateway link

Please give country-wise details of administrative price being charged for each spectrum band. Please specify in detail terms and conditions in this regard.

Around the world, charges for assignment of spectrum for space-based communications through an administrative mechanism has been derived using a cost-recovery principle. The cost benchmarks of those countries and India might vary, and it may not be appropriate to benchmark the charges for an administrative assignment with that of other countries. We suggest that India establish its own cost benchmarks, and use the administrative cost-recovery principle to charge for spectrum for space-based communications.

Q46. If the answer to above question is yes, should the administrative spectrum charges/fees be normalized for cross country differences? If yes, please specify in detail the methodology to be used in this regard?

Q47. Apart from the approaches highlighted above which other valuation approaches can be adopted for the valuation of space-based communication spectrum bands? Please support your suggestions with detailed methodology, related assumptions and other relevant factors.

Q48. Should the valuation arrived for spectrum for user link be used for valuation for spectrum for gateway links as well? Please justify.

It is possible to re-use spectrum that is used for gateway links for customer links, as well as across different geographic locations. Any separation of spectrum for use of gateway links and customer links should not be carried out. Satellite operators need flexibility to interchangeably use spectrum as the need arises.

Q49. If the answer to the above is no, what should be the basis for distinction as well as the methodology that may be used for arriving at the valuation of satellite spectrum for gateway links? Please provide detailed justification.

Q50. Whether the value arrived at by using any single valuation approach for a particular spectrum band should be taken as the appropriate value of that band? If yes, please suggest which single approach/ method should be used. Please support your answer with detailed justification.

Q51. In case your response to the above question is negative, will it be appropriate to take the average valuation (simple mean) of the valuations obtained through the different approaches attempted for valuation of a particular spectrum band, or some other approach like taking weighted mean, median etc. should be followed? Please support your answer with detailed justification.

Q52. Should the reserve price for spectrum for user link and gateway link be taken as 70% of the valuation of spectrum for shared as well as for exclusive assignment? If not, then what ratio should be adopted between the reserve price for the auction and the valuation of the spectrum in different spectrum bands in case of (i) exclusive (ii) shared assignment and why? Please support your answer with detailed justification.

Q53. If it is decided to conduct separate auctions for different class of services, should reserve price for the auction of spectrum for each service class be distinct? If yes, on what parameter basis such as revenue, subscriber base etc. this distinction be made? Please support your answer with detailed justification for each class of service.

Q54. In case of auction based and/or administrative assignment of spectrum, what should the payment terms and associated conditions for the assignment of spectrum for space-based communication services relating to:

- i. Upfront payment**
- ii. Moratorium period**
- iii. Total number of instalments to recover deferred payments**
- iv. Rate of discount in respect of deferred payment and prepayment**

Please support your answer with detailed justification.

We refer to our general comments section where we provide justification for the administrative assignment of spectrum for any space-based communication services. Spectrum should be shared between all satellite operators seeking to access it.